Publication 982 Reprint January 1959

COMMON STRAWBERRY DISEASES AND THEIR CONTROL

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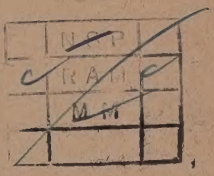

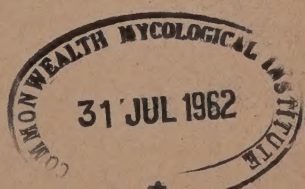

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1959

Cat. N° A43-982

COMMON STRAWBERRY DISEASES AND THEIR CONTROL

FUNGUS DISEASES

Alfred T. Bolton

LEAF SPOT

Leaf spot is the most common foliage disease of strawberries in Canada. In most regions it seldom reaches epidemic proportions. However, under favorable conditions, the disease can cause definite injury resulting in loss of vigor, smaller plants, fewer runners, and decreased yields. The fungus that causes the disease, *Mycosphaerella fragariae* (Tul.) Lindau, is capable of attacking leaves, leaf stems, fruit stems, runners, and, in some cases, the fruits themselves. The disease is most prevalent in the spring and fall when the weather is cool.

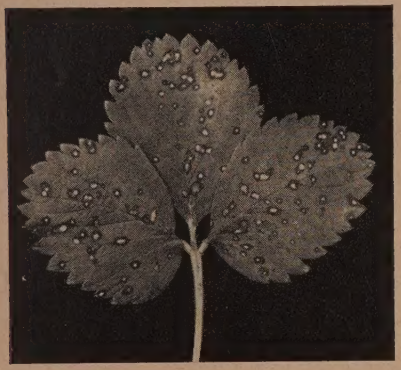

FIGURE 1. Typical leaf spot lesions on the variety Louise.

The spots first appear as very small purple areas on the upper surface of the leaves and soon enlarge to form lesions about $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter. As the lesions develop, their centers die and become light brown to white in color while their margins remain a distinct purple (Fig. 1). Under moist conditions, the dead centers become covered with tufts of spores, which are spread by splashing rain or by other means to adjacent leaves or plants. Spots similar to those on the leaves may also occur on leaf stems, fruit stems, calyxes, and runners. On the fruits, the fungus causes irregular blackened areas.

Strawberry varieties differ considerably in their susceptibility to this disease. Resistant varieties are Premier, Fairfax, Klonmore, Blakemore, and Dresden. Moderately susceptible varieties include Sparkle, Temple, Catskill, Pathfinder, and British Sovereign. Susceptible varieties are Valentine, Senator Dunlap, Louise, Elgin, Robinson and Borden.

LEAF SCORCH

Leaf scorch, caused by *Diplocarpon earliana* Ellis & Everh. Wolf, is widespread on strawberries in Eastern Canada. It also occurs in all the other provinces. Although it is not so common as leaf spot, it is much more destructive. When severe, it occurs on leaves, leaf stems, fruit stems, and runners. In some cases it has been known to destroy an entire plantation. Runner production may be completely stopped by the lesions girdling the stolons before new plants are formed.

The symptoms appear as numerous purple flecks on the upper surface of the leaves. These flecks enlarge and merge to form dark purple blotches of varying shape and size. (Fig. 2.). These lesions usually begin to develop about fruiting time, and are most severe in August and September. On the petioles,

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peduncles, and stolons the lesions are elongated and purplish. These areas enlarge until often they completely girdle the affected parts and cause the death of the leaves, fruit clusters, or runners. The drying and dying of infected tissue gives the entire plant a scorched appearance.

As the disease progresses, small black pimplelike structures or acervuli are produced in the central area of the lesions. In these structures, tiny spores are produced in very large numbers, and it is by means of these that the disease is spread, mainly by splashing rain.

FIGURE 2. Leaf scorch lesions occurring on a strawberry seedling.

Most of the popular commercial varieties are susceptible to leaf scorch. Premier, however, is resistant.

LEAF BLIGHT

This disease has been reported only from Eastern Canada and the northeastern United States, but it probably occurs throughout North America. The causal fungus, *Dendrophoma obscurans* (Ellis & Everh.) H. W. And., can be found on almost any strawberry leaf but does not ordinarily cause serious damage. It may, however, under some conditions, cause extensive losses.

FIGURE 3. Strawberry leaf showing diamond-shaped lesions caused by leaf blight.

Symptoms usually appear soon after fruiting time. Small purple, almost circular, lesions grow rapidly and leave a brown, dried-out area in the center. The lesions spread most rapidly along the veins, and therefore, many of the spots become somewhat diamond-shaped (Fig. 3). Infection often extends along the veins to the leaf margin, cutting off the food supply to the tissue between the veins, and resulting in large V-shaped dead areas which are a striking feature of the symptoms.

None of the popular commercial varieties are known to be resistant to leaf blight.

PETIOLE BLIGHT OR LEAF BLOTCH

Petiole blight is a strawberry disease that results from infection by *Gnomonia fructicola* (Arnaud) Fall. It has only recently been reported in Eastern Canada. Although it is not so common as many of the other diseases, it has been observed in several localities and is probably widespread in North America. In most cases, the damage it causes is negligible, but in 1951 it killed about 5 to 10 per cent of the plants in a few plantations.

Symptoms usually appear about fruiting time and the disease can be most readily detected by the discoloration and necrosis of the older leaves. The affected leaves usually have dark-colored lesions at the base of their stalks or petioles. The lesions eventually girdle the petioles and bring about the death of the entire leaf. There may be irregular necrotic blotches on some leaf blades. The fungus may also attack fruit stems, calyxes, and fruits.

CONTROL OF LEAF SPOT, LEAF SCORCH, LEAF BLIGHT AND PETIOLE BLIGHT

1. Select disease-free plants for new plantings.
2. Grow resistant varieties whenever possible.
3. Spray with bordeaux mixture 5-5-100 or captan 2½ lb. in 100 gal. water when growth is well started in the spring, after first blossoms appear. If the plantation is to be retained for another season, spray again after picking is completed.

POWDERY MILDEW

Powdery mildew, caused by *Sphaerotheca humuli* (DC.) Burr., can be very destructive to strawberries in Canada. It usually appears just before fruiting, and may, if weather conditions are favorable, spread over an entire plantation in a very short time and decrease yields by as much as 50 to 100 per cent. The fungus spreads rapidly in warm damp weather, but the symptoms are most conspicuous on hot, dry days.

The disease may be well established in a plantation before it is noticed because the plants show little effect from it during the early stages of infection. The first apparent symptom is an upward curling of the leaves, a condition that becomes very marked in hot weather. Closer examination will disclose a white powdery growth on the underside of the leaves and this white mycelium of the fungus may also spread to the upper surface. As the disease progresses, the leaves become noticeably discolored. In most cases the entire leaf becomes more or less reddish purple, then it dries up and dies.

Some varieties, such as Senator Dunlap, are highly susceptible to powdery mildew, while Premier and most other common commercial varieties show considerable resistance.

CONTROL OF POWDERY MILDEW

1. Grow resistant varieties if possible.
2. When mildew first appears, thoroughly cover the leaves with 15-85 copper-lime dust. Karathane has given promising results. Repeat applications at 7- to 10-day intervals, if necessary.

ROOT ROT OR BLACK ROOT

Root rot is one of the most destructive diseases of strawberries. It is the result of the combined action of several factors including soil-inhabiting fungi, bacteria, nematodes, and temperature and moisture. It is most frequently found in heavy soil and in poorly drained areas.

Plants affected with root rot show low vitality and stunting, and have a tendency to wilt and dry up in dry weather or at fruiting time. On examination the roots of wilting plants are found to be black, corky in texture, and apparently dead. The fibrous roots will have disappeared and many of the main roots will be broken off (Fig. 4). During the fruiting season, plants that have not shown any previous symptoms may suddenly wilt and die (Fig. 5). Fruits on these affected plants usually dry up instead of ripening. Premier is one of the most susceptible varieties.

CONTROL OF ROOT ROT

1. Plant only carefully selected plants with healthy roots.
2. Protect plants from winter injury by mulching.
3. Plant strawberries in well-drained soil.
4. Avoid growing strawberries in the same soil more than once in four years.

FIGURE 4. Comparison of healthy roots (left), and roots infected with root rot (right).

FIGURE 5. A wilted plant infected with root rot.

VERTICILLIUM WILT

This disease, caused by *Verticillium albo-atrum* Reinke & Berth., has only recently been encountered in Eastern Canada and British Columbia. The first symptom is a wilting of the outer leaves which soon die, to be followed by the death of the younger leaves. In some cases, the center leaves may continue to live for some time. Usually the progress of the disease is slow, but under certain conditions rapid wilting and dying of the plants may occur.

The fungus causing this disease lives in the soil and enters the plant through the roots. Because tomatoes, eggplants, potatoes, and peppers are attacked by this fungus, strawberries should not be grown on land where these crops have recently been grown.

CONTROL OF VERTICILLIUM WILT

1. Avoid planting in soil where tomatoes, potatoes, eggplants, or peppers have recently been grown.
2. Rogue out any wilted or unthrifty plants.
3. Practise crop rotation.

RED STELE

This is an important disease of strawberries in the northern and central regions of the United States, in Eastern Canada, and in British Columbia. More recently it has been found in Ontario. It is caused by *Phytophthora fragariae* Hickman. The most obvious symptoms are a stunting or dwarfing of the plants in early spring. The older leaves wilt and die and the newly formed leaves are bluish green, small, and with short stalks or petioles. The dwarfing becomes more pronounced as the season advances, and death of a great many of the badly infected plants occurs during the first dry period. Affected plants produce little or no fruit. The roots of affected plants become devoid of rootlets and die beginning at the tips and proceeding towards the crown. The central portion of these roots is red in color and this is the chief diagnostic feature of the disease.

The fungus which attacks the roots of these plants is favored by cold, wet soil and spreads most rapidly during cold rainy periods in the late fall and in the spring. It is most prevalent in low wet spots in the field.

Some of the varieties resistant to the disease are Temple, Sparkle, Aberdeen, Fairland, Vermillion, and Stelemaster.

CONTROL OF RED STELE

1. Grow resistant varieties if possible.
2. Plant only disease-free plants.
3. Practise a 3- or 4-year rotation.
4. Control has been obtained by treating infected soil with nabam at a concentration of 6 qt. to 100 gal. water applied at the rate of 2,000 gal. per acre. This treatment, however, is not economically practicable.

GRAY MOLD

FIGURE 6. Strawberry fruits affected with gray mold.

The causal organism is *Botrytis cinerea* Pers. Gray mold causes the most common fruit rot of strawberries in Canada. It affects both green and ripe fruits in the field as well as fruit in transit and storage, and causes them to become discolored and decayed. The presence of the disease may be indicated by brown spots on the fruit, or by the fungus itself which may be seen growing on the surface as a gray, powdery, fluffy mat (Fig. 6).

The disease often becomes severe during warm, humid weather at fruiting time, and may attack from 20 to 60 per cent of the fruit. It is usually more severe on soft-fruited varieties that produce thick, luxuriant foliage.

LEAK

This disease is common on strawberry fruits in transit and storage and is caused by the common black bread mold (*Rhizopus* sp.). It is characterized by the collapse of the fruits accompanied by the loss of a large amount of juice which may drip from the boxes or crates; hence the common name. Growth of the fungus and spread of the disease is favored by humid atmosphere and high temperature, and occurs most readily on bruised fruit.

CONTROL OF GRAY MOLD AND LEAK

1. Avoid excessive use of nitrogenous fertilizers in the spring.
2. Mulching helps reduce fruit rots, since the mulch helps to keep the fruits from coming in contact with the soil and allows for better aeration.
3. Careful handling of the berries and storage at low temperatures will aid greatly in the control of leak.
4. Spray with captan at a concentration of $2\frac{1}{2}$ lb. in 100 gal. of water at 5- to 7-day intervals from the first time blossoms appear until 10 days before harvest.

VIRUS DISEASES

Randal E. Fitzpatrick and Frances C. Mellor.

Strawberries are susceptible to infection by a number of viruses. Viruses are organisms too small to be seen with the ordinary microscope. Their presence is usually suspected from the way in which the plant behaves when it is infected. The viruses can multiply in the plant tissues. In the strawberry they are spread from plant to plant by aphids, which are insects that live by sucking the plant juices. Unlike some viruses affecting other plants, the strawberry viruses cannot be spread by merely rubbing the juice from a diseased strawberry plant on a healthy one. There are several species of aphids that feed on strawberries, but the commonest one, and the one that seems to be largely responsible for the spread of the viruses, is the green strawberry aphid, *Capitophorus fragaefolii*(Ckll.).

In strawberries virus infection usually causes a decline in vigor and cropping potentially rather than an outright killing of the plant. How seriously the plant is injured depends on the virus or mixture of viruses present and on the degree to which the particular variety is susceptible or tolerant to injury from them. Most commercial varieties are relatively tolerant of infection by single viruses, but certain virus combinations can have devastating effects.

The two most common diseases of this type are xanthosis, which is usually called yellow-edge in Eastern Canada and yellows in British Columbia, and crinkle.

XANTHOSIS (YELLOW-EDGE, YELLOWS)

This disease is characterized by a marked reduction in the vigor and yield of the plants. The plants tend to become flattened. The center leaves of the crown are distinctly and often brilliantly yellow, particularly towards their margins. These leaves are much reduced in size, and often slightly twisted and cupped upward. The older leaves tend to turn red early in the summer. In recently infected fields the groups of yellowed, stunted plants stand out conspicuously in contrast to the normal healthy plants and give an "up-and-down" appearance to the crop rows.

Xanthosis is now known to be caused by the combination of at least two viruses. Each of these viruses produces distinctive symptoms on certain species of wild strawberry, but singly they appear to have little or no effect on most commercial varieties. Their combination in such varieties as Marshall and Royal Sovereign produces typical xanthosis, but in Premier, Glen Mary, Parson's Beauty, and British Sovereign, while the plants decline noticeably, the characteristic yellowing is not pronounced.

A few varieties such as Northwest and Huxley are extremely tolerant and after infection show little or no reduction in vigor. Needless to say, such varieties should never be grown near the others as they will act as a constant reservoir of virus for the infection of the less tolerant plants.

CRINKLE

Crinkle, as the name implies, is characterized by a distortion and wrinkling of the leaves, which are mottled with lighter green or yellow. The first symptoms appear as yellow pin-point spots on the developing leaves. These spots later turn purple or brown, the tissue in them dies, and this localized killing results in the crinkling of the expanding leaf. Seriously affected plants are considerably reduced in vigor.

Less is known of the viruses that cause crinkle than is of those causing xanthosis, but it is probable that more than one virus is involved, and recent work indicates that crinkle may be caused by more than one virus or virus combination.

Crinkle has been serious on Marshall and Royal Sovereign varieties but it has not been seen on British Sovereign.

RECOMMENDATIONS FOR REDUCING LOSSES

Strawberry plants infected with viruses cannot be cured by any ordinary treatment. If diseases such as xanthosis or crinkle are recognized at the time of planting, the plants should be removed and destroyed, and any plants that develop symptoms subsequently should be rogued out as soon as they are recognized. Runners from diseased plants should never be used in propagation, and if possible, runner plants should not be taken even from the healthy plants in fields where disease is known to be present. Wherever possible plants that can be certified to be free of virus should be used when setting out new plantations.

Tolerant varieties, such as Northwest, should never be planted in conjunction with or near other varieties.

Where special beds are being set up for the propagation of runners, only the best available stock should be used, the beds should be located as far as possible from commercial plantings, and an efficient aphicide spray or dust should be applied regularly.

NONINFECTIOUS LEAF VARIEGATION OR JUNE YELLOWS

Some strawberry varieties are prone to produce yellow or variegated plants spontaneously. This trouble is not a disease in the usual sense, but is due to some inherited factor. There is no cure, but propagation from plants that appear normal may produce a clone that is free of the trouble. However, even with careful selection, only partial success can be expected.